

REMARKS

I. Introduction

The Office Action of September 18, 2009 has been reviewed and the Examiner's comments carefully considered. Claims 6-12 and 14-23 are pending in this application. The present Amendment amends claims 11 and 21-23 all in accordance with the originally-filed specification. No new matter has been added by this Amendment. Specifically, support for this Amendment can be found in Samples 17 and 18 of table 1 on page 15 of the specification of the present application. Additionally, claims 6-10, 12, 14, and 16 were withdrawn from further consideration in view of an earlier restriction requirement. The Applicants reserve the right to file a divisional application directed to the non-elected claims. Accordingly, claims 11, 15, and 17-23 are currently under examination in this application, and claims 11 and 21-23 are in independent form.

II. Interview of November 24, 2009

The Applicants would like to thank Examiners Roe and King for the courtesies extended to the Applicants' representative during the telephonic interview of November 24, 2009. During the interview, the Examiner discussed the prior art rejections and stressed the experimental data presented in Declaration 1. More specifically, the Applicants' representative set forth arguments that United States Patent No. 6,261,517 to Kaneko et al. (hereinafter "the Kaneko patent") fails to teach or suggest the a-axis length and the pulverization residual rate of the storage alloy as required by independent claims 11 and 21-23. While the Examiner agreed that the Kaneko patent did not teach or suggest these elements of the independent claims, the Examiner further contended that these features would be obvious in view of the teaching that axis length varies depending on heat-treatment condition in the article entitled "Improvement of Characteristics of Hydrogen Storage of Mischmetal-Nickel-Manganese Alloy" to Suzuki et al. (hereinafter "the Suzuki article"). However, the Examiner further indicated that this rejection could be overcome by: 1) amending independent claims 11 and 21-23 to provide ranges for a, b, c, and/or d that are outside of the ranges of a, b, c, and/or d as disclosed by the Kaneko patent; and/or 2) submitting additional evidence, in the form of another Declaration under 37 C.F.R. § 1.132, showing the criticality of the claimed ranges of a, b, c, and d.

Pursuant to the Examiner's suggestion, the Applicants have amended claims 11 and 21-23 to require the range of Al (i.e., c) to be outside the range of Al disclosed in the Kaneko patent.

III. 35 U.S.C. § 112, Second Paragraph Rejections

Claims 11, 15, and 17-23 stand rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the Applicants regard as the invention. The Applicants believe that the above amendments to independent claims 11 and 21-23 overcome the Examiner's indefiniteness rejection. Reconsideration and withdrawal of this rejection are respectfully requested.

IV. 35 U.S.C. § 103 Rejections

Claims 11, 15, and 17-23 stand rejected under 35 U.S.C. § 103(a) for obviousness based upon the Kaneko patent alone, or alternatively in view of the Suzuki article. In view of the above amendments and the following remarks, the Applicants respectfully request reconsideration of this rejection.

As defined by amended independent claim 11, the present invention is directed to a low Co hydrogen storage alloy having a CaCu_5 crystal structure that can be represented by the general formula $\text{MmNi}_a\text{Mn}_b\text{Al}_c\text{Co}_d$. Mm is a Misch metal, $4.31 \leq a \leq 4.7$, $0.3 \leq b \leq 0.65$, $0.2 \leq c < 0.37$, $0 < d \leq 0.35$. In a composition of $5.25 \leq a + b + c + d < 5.30$, the a-axis length of the crystal lattice is not less than 500.5 pm and not more than 502.7 pm, and the c-axis length is not less than 405.6 pm and not more than 406.9 pm. The pulverization residual rate obtained by the following equation is 50% or more: Pulverization residual rate (%) = (post-cycling particle size/pre-cycling particle size) x 100. When a hydrogen storage alloy is ground and screened to select particles with a particle size in the range of 20 μm and 53 μm to provide hydrogen storage alloy powder, and after measuring with a particle size distribution measuring device the average particle size (pre-cycling particle size, D_{50}) of the hydrogen storage alloy powder; 2 g of the hydrogen storage alloy powder is weighed and placed into a PCT holder; the surfaces thereof are cleaned twice under hydrogen pressure of 1.75 MPa; then activation is carried out twice by introducing hydrogen of 3 MPa; next, a cycle test using a PCT device is then repeated 50 times,

wherein hydrogen gas of 3 MPa is introduced into 2.0 g of the hydrogen storage alloy powder to absorb hydrogen, and the hydrogen is desorbed at 45°C; and the average particle size of the hydrogen storage alloy powder after the test of the 50 cycles (post-cycling particle size, D_{50}) is measured with a particle size distribution measuring device.

As defined by amended independent claim 21, the present invention is directed to a low Co hydrogen storage alloy having a CaCu_5 crystal structure that can be represented by the general formula $\text{MmNi}_a\text{Mn}_b\text{Al}_c\text{Co}_d$. Mm is a Misch metal, $4.31 \leq a \leq 4.7$, $0.3 \leq b \leq 0.65$, $0.2 \leq c < 0.37$, $0 < d \leq 0.35$. In a composition of $5.30 \leq a + b + c + d < 5.35$, the a-axis length of the crystal lattice is not less than 500.0 pm and not more than 502.4 pm, and the c-axis length is not less than 405.9 pm and not more than 407.2 pm. The pulverization residual rate obtained by the following equation is 50% or more: Pulverization residual rate (%) = (post-cycling particle size/pre-cycling particle size) x 100. When a hydrogen storage alloy is ground and screened to select particles with a particle size in the range of 20 μm and 53 μm to provide hydrogen storage alloy powder, and after measuring with a particle size distribution measuring device the average particle size (pre-cycling particle size, D_{50}) of the hydrogen storage alloy powder; 2 g of the hydrogen storage alloy powder is weighed and placed into a PCT holder; the surfaces thereof are cleaned twice under hydrogen pressure of 1.75 MPa; then activation is carried out twice by introducing hydrogen of 3 MPa; next, a cycle test using a PCT device is then repeated 50 times, wherein hydrogen gas of 3 MPa is introduced into 2.0 g of the hydrogen storage alloy powder to absorb hydrogen, and the hydrogen is desorbed at 45°C; and the average particle size of the hydrogen storage alloy powder after the test of the 50 cycles (post-cycling particle size, D_{50}) is measured with a particle size distribution measuring device.

As defined by amended independent claim 22, the present invention is directed to a low Co hydrogen storage alloy having a CaCu_5 crystal structure that can be represented by the general formula $\text{MmNi}_a\text{Mn}_b\text{Al}_c\text{Co}_d$. Mm is a Misch metal, $4.31 \leq a \leq 4.7$, $0.3 \leq b \leq 0.65$, $0.2 \leq c < 0.37$, $0 < d \leq 0.35$. In a composition of $5.35 \leq a + b + c + d < 5.40$, the a-axis length of the crystal lattice is not less than 499.8 pm and not more than 502.3 pm, and the c-axis length is not less than 406.0 pm and not more than 407.3 pm. The pulverization residual rate obtained by the following equation is 50% or more: Pulverization residual rate (%) = (post-cycling particle size/pre-cycling particle size) x 100. When a hydrogen storage alloy is ground and screened to

select particles with a particle size in the range of 20 μm and 53 μm to provide hydrogen storage alloy powder, and after measuring with a particle size distribution measuring device the average particle size (pre-cycling particle size, D_{50}) of the hydrogen storage alloy powder; 2 g of the hydrogen storage alloy powder is weighed and placed into a PCT holder; the surfaces thereof are cleaned twice under hydrogen pressure of 1.75 MPa; then activation is carried out twice by introducing hydrogen of 3 MPa; next, a cycle test using a PCT device is then repeated 50 times, wherein hydrogen gas of 3 MPa is introduced into 2.0 g of the hydrogen storage alloy powder to absorb hydrogen, and the hydrogen is desorbed at 45°C; and the average particle size of the hydrogen storage alloy powder after the test of the 50 cycles (post-cycling particle size, D_{50}) is measured with a particle size distribution measuring device.

As defined by amended independent claim 23, the present invention is directed to a low Co hydrogen storage alloy having a CaCu_5 crystal structure that can be represented by the general formula $\text{MmNi}_a\text{Mn}_b\text{Al}_c\text{Co}_d$. Mm is a Misch metal, $4.31 \leq a \leq 4.7$, $0.3 \leq b \leq 0.65$, $0.2 \leq c < 0.37$, $0 < d \leq 0.35$. In a composition of $5.40 \leq a + b + c + d < 5.45$, the a-axis length of the crystal lattice is not less than 499.7 pm and not more than 502.3 pm, and the c-axis length is not less than 406.1 pm and not more than 407.4 pm. The pulverization residual rate obtained by the following equation is 50% or more: Pulverization residual rate (%) = (post-cycling particle size/pre-cycling particle size) x 100. When a hydrogen storage alloy is ground and screened to select particles with a particle size in the range of 20 μm and 53 μm to provide hydrogen storage alloy powder, and after measuring with a particle size distribution measuring device the average particle size (pre-cycling particle size, D_{50}) of the hydrogen storage alloy powder; 2 g of the hydrogen storage alloy powder is weighed and placed into a PCT holder; the surfaces thereof are cleaned twice under hydrogen pressure of 1.75 MPa; then activation is carried out twice by introducing hydrogen of 3 MPa; next, a cycle test using a PCT device is then repeated 50 times, wherein hydrogen gas of 3 MPa is introduced into 2.0 g of the hydrogen storage alloy powder to absorb hydrogen, and the hydrogen is desorbed at 45°C; and the average particle size of the hydrogen storage alloy powder after the test of the 50 cycles (post-cycling particle size, D_{50}) is measured with a particle size distribution measuring device.

The Kaneko patent is directed to a rare earth metal-nickel hydrogen storage alloy of a composition represented by the formula: $\text{RNi}_a\text{Mn}_b\text{Co}_c\text{Al}_d\text{X}_e$, where R stands for one or

more rare earth elements including Sc and Y, not less than 95 atom % of which is one or more elements selected from the group consisting of La, Ce, Pr, and Nd; X stands for one or more elements selected from the group consisting of Fe, Cu, Zn, V, and Nb; a, b, c, d, and e satisfy the relations of $3.9 \leq a < 6.0$, $0.45 \leq b < 1.5$, $0.01 \leq c < 0.3$, $0.4 \leq d < 1$, $0 \leq e \leq 0.2$, and $5.2 \leq a+b+c+d+e \leq 7.5$, the alloy having a matrix of CaCu_5 structure, and a Mn-rich secondary phase of 0.3 to 5 μm is finely dispersed in the matrix at surface ratio of 0.3 to 7%.

Pursuant to the Examiner's suggestion during the interview of November 24, 2009, the Applicants have amended independent claims 1 and 21-23 to require the range of Al (i.e., c) to be outside the range of Al disclosed in the Kaneko patent. More specifically, independent claims 1 and 21-23 have been amended to require the claimed low Co hydrogen storage alloy, represented by the general formula $\text{MmNi}_a\text{Mn}_b\text{Al}_c\text{Co}_d$, to have Al in the following range: $0.2 \leq c < 0.37$. The Kaneko patent does not teach or suggest such a feature. Instead, in the Kaneko patent, the range for Al is $0.4 \leq d \leq 1$ (see the Abstract of the Kaneko patent). Accordingly, the Kaneko patent does not teach or suggest a range of Al as required by the claimed invention. The Suzuki article is directed to Mischmetal-Nickel-Manganese hydrogen storage alloy, and is provided by the Examiner as allegedly disclosing that the axis length varies depending on heat treatment conditions. The Suzuki article does not cure the deficiencies of the Kaneko patent.

In addition, the range of Al of the amended independent claims would not be obvious in view of the Kaneko patent, whether considered alone or in combination with the Suzuki article. A prior art reference must be considered for all of its teachings, including a disclosure that diverges and teaches away from the invention at hand as well as disclosures that point toward and teach the invention when interpreting the patentability of a claim. A *prima facie* case of obviousness cannot exist where a reference teaches away from the claimed invention. The Kaneko patent clearly teaches away from Applicants' claimed range of Al of $0.2 \leq c < 0.37$ by stating that "Al is in the range of $0.4 \leq d \leq 1$, preferably $0.5 \leq d \leq 0.7$. If 'd' is less than 0.4, the hydrogen equilibrium pressure of the alloy increases, and the corrosion resistance of the alloy decreases" (Emphasis added).

Accordingly, the Kaneko patent, whether considered alone or in combination with the Suzuki article, teaches away from the claimed invention and the advantages and properties of

the hydrogen storage alloy of the present invention cannot be expected from the hydrogen storage alloy of the Kaneko patent.

Furthermore, the Kaneko patent, whether considered alone or in combination with the Suzuki article, does not teach or suggest, and in fact, does not even mention that the low Co hydrogen storage alloy requires, in a composition of $5.25 \leq a + b + c + d < 5.30$, that the a-axis length of the crystal lattice is not less than 500.5 pm and not more than 502.7 pm, and the c-axis length is not less than 405.6 pm and not more than 406.9 pm as required by independent claim 11; in a composition of $5.30 \leq a + b + c + d < 5.35$, that the a-axis length of the crystal lattice is not less than 500.0 pm and not more than 502.4 pm, and the c-axis length is not less than 405.9 pm and not more than 407.2 pm as required by independent claim 21; in a composition of $5.35 \leq a + b + c + d < 5.40$, that the a-axis length of the crystal lattice is not less than 499.8 pm and not more than 502.3 pm, and the c-axis length is not less than 406.0 pm and not more than 407.3 pm as required by independent claim 22; or, in a composition of $5.40 \leq a + b + c + d < 5.45$, that the a-axis length of the crystal lattice is not less than 499.7 pm and not more than 502.3 pm, and the c-axis length is not less than 406.1 pm and not more than 407.4 pm as required by independent claim 23.

As stated in paragraphs [0070] and [0071] of the specification of the above-referenced application, the a-axis length and c-axis length of the crystal lattice are greatly influenced by casting conditions and heat-treatment conditions. Although a component composition of the alloy of the Kaneko patent and the alloy of the claimed invention overlap, the a-axis length and the c-axis length are not the same. This is evident from the findings set forth in the Declaration under 37 C.F.R. § 1.132 of Shinya Kagei submitted with the Amendment of July 7, 2009 and labeled Declaration 1 (hereinafter "Declaration 1"). Declaration 1 sets forth experimental data that confirms that the a-axis length and the pulverization residual rate of the storage alloy disclosed in the Kaneko patent do not fall within the range specified in independent claims 11 and 21-23 by reproducing Example I of the Kaneko patent. This experimental data clearly shows the hydrogen storage alloy of the Kaneko patent does not have an a-axis length that falls within the claimed range (*see* paragraph 6 of Declaration 1) and the pulverization residual rate of the hydrogen storage alloy does not fall within the claimed range (*see* paragraph 6 of Declaration 1).


For the foregoing reasons, the Applicants believe that the subject matter of amended independent claims 11 and 21-23 is not obvious in view of the combination of the Kaneko patent and the Suzuki article. Reconsideration and withdrawal of the rejection of claims 11 and 21-23 are respectfully requested.

Claims 15 and 17-20 depend from and add further limitations to independent claim 11 and are believed to be patentable for at least the reasons discussed hereinabove in connection with independent claim 11. Reconsideration and withdrawal of the rejection of claims 15 and 17-20 are respectfully requested.

V. Conclusion

Based on the foregoing amendments and remarks, reconsideration of the rejections and allowance of pending claims 11, 15, and 17-23 are respectfully requested. Should the Examiner have any questions or wish to discuss the application in further detail, the Examiner is invited to contact Applicants' undersigned representative by telephone at 412-471-8815.

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